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CONTRIBUTIONS FROM THE ZOÖLOGICAL LABORATORY OF THE MUSEUM OF COMPARATIVE ZOÖLOGY AT HARVARD COLLEGE. E. L. MARK, DIRECTOR. No. 167.

A CASE OF ABNORMAL VENOUS SYSTEM IN *NECTURUS MACULATUS.*

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In all classes of vertebrates variations in the morphology of the circulatory system are by no means infrequent. Indeed, one rarely, if ever, finds two individuals with precisely the same arrangement of the blood-vessels. Even in cases in which the vessels are for the most part symmetrical, the smaller vessels, particularly the veins, are found to vary more or less on opposite sides of the body, as is readily shown by a comparison of the superficial veins of one's own forearms or the backs of the hands.

The literature on abnormalities of the blood-vessels shows that they often may involve even the largest and most important veins of the body, such as the postcava and its tributaries. It has been observed that in the venous system of some vertebrates the cases of variation are more frequent than those of the "normal" condition. Thus McClure (:00 a) finds variations in the opossum of such frequent occurrence and of so definite a character as to suggest probable phylogenetic relations.

The literature on abnormalities of the veins in Urodela shows records of several cases, mostly in European salamanders. Hochstetter ('88, p. 164) describes a condition in *Salamandra maculosa* in which the postcava did not pass through the liver, but was continuous with the much enlarged right posterior cardinal vein, the two forming a single vessel passing straight to the venous sinus. He also briefly mentions similar abnormalities seen in specimens of *Siredon pisciformis.*

Joseph (:01) observed in *Salamandra maculosa* a similar case, in which, however, it was the left cardinal that was hypertrophied. In another case (also *S. maculosa*) described by Joseph, there were two abnormally large, symmetrical veins on the ventral surface of the liver, one on each side of the suspensory ligament. (Normally, according to Hochstetter, there is but one large hepatic vein, which is in the left half of the liver.) They ended separately in the venous sinus, which was, in his opinion, the enlarged end of the left vein. The right vein he found continuous with the postcava within the liver. According to his description and figures, the postcava entered the dorsal surface of the posterior end of the liver, passed forward through the liver substance, as it does normally, then became continuous with the right superficial vein ventrally, near the junction of the anterior and middle thirds of the liver.

The following anomaly was observed in the veins of a specimen of *Necturus maculatus* injected for dissection of the vascular system. The work was done in connection with the course on comparative anatomy given by Dr. H. W. Rand at Harvard University. Although annually for some years past many of these amphibians have been used for dissection and injection, no similar condition has been noted. This case is of interest, not only on account of its rarity and the profound alterations involving the chief veins of the body, but also because it is, so far as I know, the first instance of the kind observed in Necturus. Moreover, it differs markedly from all similar cases previously reported. Before giving an account of this abnormal condition, it may be well to describe briefly the normal arrangement of the corresponding veins.

The postcava (Fig. 1) begins as a median trunk lying between the kidneys; passes anteriad ventral to the aorta, which it leaves at a point near the posterior border of the liver; bends ventrad to enter the dorsal surface of the posterior end of the liver, through which it passes anteriad and within which it receives the hepatic veins; emerges on the ventral surface of the anterior end of the liver; bifurcates, then reunites and ends in (or rather is continuous with) the venous sinus at the point where the ducts of Cuvier enter laterally. The right and left posterior cardinals arise from the convexity of the bend in the postcava

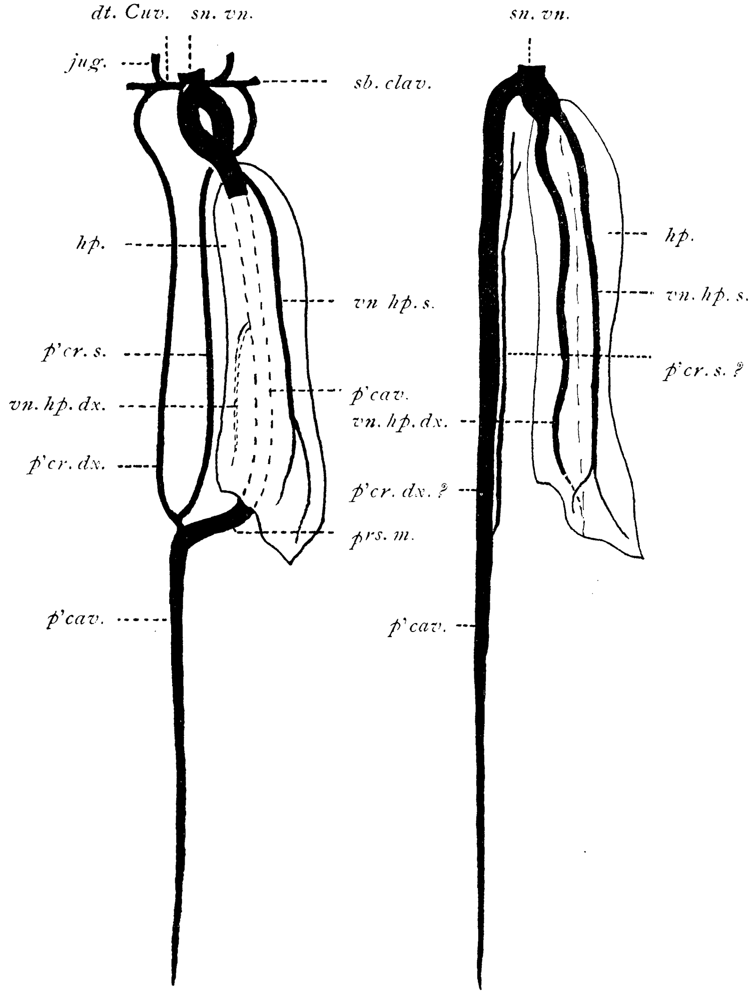

Fig. 1. Fig. 2.

The figures represent the central portion of the venous system of *Necturus maculatus* seen from the ventral side and are about one half natural size. The liver is shown displaced slightly to the left of the median plane. Fig. 1 represents the normal condition, the veins within the liver being indicated by broken lines. In Fig. 2 the attachment of the suspensory ligament is indicated by a broken line. *dt. Cuv.*, duct of Cuvier; *hp.*, liver; *jug.*, jugular vein; *p'cav.*, postcava; *p'cr. dx.*, right posterior cardinal vein; *p'cr. s.*, left posterior cardinal vein; *prs. m.*, "Mittelstück" of postcava; *sb. clav.*, subclavian vein; *sn. vn.*, venous sinus; *vn. hp. dx.*, right hepatic vein; *vn. hp. s.*, left hepatic vein.

where it leaves the aorta, and they pass anteriad to terminate in the corresponding ducts of Cuvier, close to the venous sinus. The cardinals may arise from the postcava either separately or by a short common trunk. According to Miller (:00), the latter condition is the more usual. Posteriorly the cardinals anastomose with the renal portals, which have been omitted from the figure as not bearing upon the abnormalities here considered. The hepatic veins are variable in number, size, and termination; but Miller finds that two are larger and more constant than the others. One joins the postcava near the center, the other at the anterior end, of the liver. It is to be noted that in *Salamandra maculosa* there is normally but one large hepatic vein, which is in the left half of the liver (Hochstetter).

In the abnormal case (Fig. 2) the postcava arose normally between the kidneys, but instead of entering the liver, it became continuous anteriorly with a large and apparently median vessel which passed directly anteriad along the dorsal body wall to the heart, without receiving any hepatic veins. The end toward the heart lay somewhat to the right of the median plane and entered the venous sinus from the right side. The hepatics were two very large symmetrical veins, superficial on the ventral side of the liver for their entire length, one on each side of the suspensory ligament. They united at the anterior end of the liver to form a short, bulbous trunk, the anterior end of which was directly continuous with the venous sinus. The left hepatic vein was fairly straight and arose from the posterior end of the liver, where it received a small superficial tributary from the right side of the posterior border. The right one, of about the same size, was more irregular in its course. Its beginning was imbedded in the substance of the liver on the right side of its posterior extremity. Both received small hepatic branches within the liver, as was shown by sectioning.

About one centimeter posterior to the venous sinus and to the left of the median plane, there arose from the body wall a small vein formed by the union of two short branches. In its course posteriad it gradually approached the large median vein described above and passed along its dorsal surface, to which it was intimately attached. Its size increased slightly as it passed posteriad. By careful dissection it was separated to a point opposite the posterior extremity of the liver. Here it was unintentionally severed from the postcava at what is believed to have been its point of entrance, as it could not be traced any farther. Its junction with the postcava could not be determined positively on account of its small size, the injury to the delicate wall of the postcava, and the exudation of the injected starch mass. The identity of this vessel is open to question, but from its relations and course, and by analogy with the somewhat similar cases mentioned above, it was most probably the atrophied left posterior cardinal corresponding to the very much hypertrophied right posterior cardinal, which was functioning as the anterior part of the postcava.

No further abnormalities were observed in either the circulatory or other systems.

Comparing this case with the normal venous system and considering the development of the postcava, it is inferred that *the right hepatic vein* (*or at least the anterior part of it*) *represents the anterior part of the normal postcava, the normal "Mittelstück" of the postcava having failed to develop.* Wiedersheim ('98, p. 371), speaking of the development of the postcava in Amphibia, says: "Der vordere (Leber) Abschnitt entstammt offenbar zum Theil der rechten V. omphalo-mesenterica, zum Theil aber entsteht er unabhängig." Hochstetter ('88) states concerning the development of the postcava in Salamandra: "Das Wesentliche an der Hohlvenenbildung ist demnach die Verbindung zwischen Lebervenen und Cardinalvenen und die Verschmelzung der Cardinalvenen in ihrem Urnierenabschnitte" (p. 167); .... "diese Verschmelzung erfolgt übrigens erst ziemlich spät, nachdem der sich ganz selbständig entwickelnde Abschnitt der vorderen Hohlvene sich mit der rechten Cardinalvene in Verbindung gesetzt hat...." (p. 163). "Ausnahmsweise kommt es manchmal vor, dass die Entwicklung eines vorderen Hohlvenenabschnittes vollständig ausbleibt, dann bildet sich entweder die rechte oder linke Cardinalvene weiter aus und führt im erwachsenen Thiere das Blut der Nieren, Geschlechtsorgane und des Rumpfes dem Herzen zu" (p. 164).

In comparison with the abnormal cases previously described, this case of Necturus possesses in the hypertrophied right posterior cardinal, the characteristics of one of Hochstetter's, and in the two large symmetrical hepatic veins, those of one of Joseph's, although, upon the whole, it is strikingly different from both.

BIBLIOGRAPHY.

HOCHSTETTER, F.
'88. Beiträge zur vergleichenden Anatomie und Entwicklungsgeschichte des Venensystems der Amphibien und Fische. *Morph. Jahrb.*, Bd. 13, pp. 119–172, Taf. II–IV, 7 Textfig.
JOSEPH, H.
:01. Ueber zwei Abnormitäten im Venensystem von Salamandra maculosa Laur. *Anat. Anz.*, Bd. 20, pp. 283–293, 4 text figs.
MCCLURE, C. F. W.
:00. On the Frequency of Abnormalities in Connection with the Postcaval Vein and its Tributaries in the Domestic Cat (*Felis domestica*). *Amer. Nat.*, vol. 34, pp. 185–198, 9 text figs.
MCCLURE, C. F. W.
:00a. The Variations of the Venous System in *Didelphys virginiana*. *Anat. Anz.*, Bd. 18, pp. 441–460, 21 Text figs.
MILLER, W. S.
:00. The Vascular System of *Necturus maculatus*. *Bull. Univ. Wisconsin* (*Sci. Series*), no. 33, pp. 211–226, pls. 9–11.
SLONAKER, J. R.
:00. A Strange Abnormality in the Circulatory System of the Common Rabbit (*Lepus sylvaticus*). *Amer. Nat.*, vol. 34, pp. 639–640, 1 fig.
WIEDERSHEIM, R.
'98. Grundniss der vergleichenden Anatomie der Wirbelthiere. 4te, Aufl., Jena, xxiii + 559 pp.